

WHAT IS CLAIMED IS:

1 1. An optical amplifying apparatus comprising:
2 a plurality of pumping sources generating
3 pumping light beams at different wavelengths;
4 a Raman amplification medium receiving the
5 pumping light beams from said pumping sources to
6 amplify a main signal light beam by using stimulated
7 Raman scattering phenomenon due to said pumping light
8 beams;
9 a rare-earth-doped optical amplification
10 medium receiving said main signal light beam amplified
11 by said Raman amplification medium to further amplify
12 said main signal light beam; and
13 a pumping light introducing means
14 introducing a part or all of a pumping light beam at
15 a specific wavelength of said pumping light beams as
16 a pumping light beam for said rare-earth-doped optical
17 amplification medium to said rare-earth-doped
18 optical amplification medium.

1 2. The optical amplifying apparatus according to claim
2 1, wherein said pumping light introducing means is a
3 reflection-type fiber grating disposed between said
4 Raman amplification medium and said rare-earth-doped
5 optical amplification medium to reflect a part of said
6 pumping light beam at said specific wavelength to said

7 rare-earth-doped optical amplification medium, and
8 transmitting a rest of said pumping light beam to said
9 Raman amplification medium.

1 3. The optical amplifying apparatus according to claim
2, wherein said pumping light introducing means
3 introduces a pumping light beam at a longer wavelength
4 as said pumping light beam at said specific wavelength
5 to said rare-earth-doped optical amplification
6 medium.

1 4. The optical amplifying apparatus according to claim
2, wherein said pumping sources intensity-modulate
3 said pumping light beams according to monitoring
4 control information to be transmitted.

1 5. The optical amplifying apparatus according to claim
2 1, wherein said pumping light introducing means is an
3 optical coupler disposed between said Raman
4 amplification medium and said rare-earth-doped
5 optical amplification medium to split said pumping
6 light beam at said specific wavelength, introducing
7 a part of said pumping light beam at said specific
8 wavelength to said rare-earth-doped optical
9 amplification medium, and introducing a rest of said
10 pumping light beam to said Raman amplification medium.

1 6. The optical amplifying apparatus according to claim
2 5, wherein said pumping light introducing means
3 introduces a pumping light beam at a longer wavelength
4 as said pumping light beam at said specific wavelength
5 to said rare-earth-doped optical amplification
6 medium.

1 7. The optical amplifying apparatus according to claim
2 5, wherein said pumping sources intensity-modulate
3 said pumping light beams according to monitoring
4 control information to be transmitted.

1 8. The optical amplifying apparatus according to claim
2 1, wherein said pumping light introducing means
3 introduces a pumping light beam at a longer wavelength
4 as said pumping light beam at said specific wavelength
5 to said rare-earth-doped optical amplification
6 medium.

1 9. The optical amplifying apparatus according to claim
2 8, wherein said pumping sources intensity-modulate
3 said pumping light beams according to monitoring
4 control information to be transmitted.

1 10. The optical amplifying apparatus according to
2 claim 1, wherein said pumping sources
3 intensity-modulate said pumping light beams

4 according to monitoring control information to be
5 transmitted.

1 11. An optical amplifying apparatus comprising:
2 a plurality of counterpropagating pumping
3 sources generating pumping light beams at different
4 wavelengths;

5 a copropagating pumping source generating a
6 pumping light beam at a specific wavelength identical
7 to at least any one of said wavelengths of said pumping
8 light beams generated by said counterpropagating
9 pumping sources;

10 a Raman amplification medium receiving
11 pumping light beams from said counterpropagating
12 pumping sources from one direction and receiving said
13 pumping light beam from said copropagating pumping
14 source from other direction to amplify a main signal
15 light beam by using stimulated Raman scattering
16 phenomenon due to said pumping light beams from said
17 both directions;

18 a rare-earth-doped optical amplification
19 medium receiving said main signal light beam amplified
20 by said Raman amplification medium to further amplify
21 said main signal light beam; and

22 a pumping light introducing means
23 introducing a part or all of said pumping light beam
24 at said specific wavelength of said pumping light

25 beams from said counterpropagating pumping sources as
26 a pumping light beam for said rare-earth-doped optical
27 amplification medium to said rare-earth-doped
28 optical amplification medium, and transmitting at
29 least said pumping light beam at said specific
30 wavelength from said copropagating pumping source as
31 another pumping light beam for said rare-earth-doped
32 optical amplification medium.

1 12. The optical amplifying apparatus according to
2 claim 11, wherein said pumping light introducing means
3 is a reflection-type fiber grating disposed between
4 said Raman amplification medium and said
5 rare-earth-doped optical amplification medium to
6 reflect a part of said pumping light beam at said
7 specific wavelength to said rare-earth-doped optical
8 amplification medium, transmitting a rest of said
9 pumping light beam to said Raman amplification medium,
10 and transmitting said pumping light beam from said
11 copropagating pumping source to said
12 rare-earth-doped optical amplification medium.

1 13. The optical amplifying apparatus according to
2 claim 12, wherein said pumping light introducing means
3 introduces a pumping light beam at a longer wavelength
4 as said pumping light beam at said specific wavelength
5 to said rare-earth-doped optical amplification

6 medium.

1 14. The optical amplifying apparatus according to
2 claim 12, wherein said pumping sources
3 intensity-modulate said pumping light beams
4 according to monitoring control information to be
5 transmitted.

1 15. The optical amplifying apparatus according to
2 claim 11, wherein said pumping light introducing means
3 is an optical coupler disposed between said Raman
4 amplification medium and said rare-earth-doped
5 optical amplification medium to split said pumping
6 light beam at said specific wavelength, introducing
7 a part of said pumping light beam at said specific
8 wavelength to said rare-earth-doped optical
9 amplification medium, introducing a rest of said
10 pumping light to said Raman amplification medium, and
11 transmitting a pumping light beam from said
12 copropagating pumping source to said
13 rare-earth-doped optical amplification medium.

1 16. The optical amplifying apparatus according to
2 claim 15, wherein said pumping light introducing means
3 introduces a pumping light beam at a longer wavelength
4 as said pumping light beam at said specific wavelength
5 to said rare-earth-doped optical amplification

6 medium.

1 17. The optical amplifying apparatus according to
2 claim 15, wherein said pumping sources
3 intensity-modulate said pumping light beams
4 according to monitoring control information to be
5 transmitted.

1 18. The optical amplifying apparatus according to
2 claim 11, wherein said pumping light introducing means
3 introduces a pumping light beam at a longer wavelength
4 as said pumping light beam at said specific wavelength
5 to said rare-earth-doped optical amplification
6 medium.

1 19. The optical amplifying apparatus according to
2 claim 18, wherein said pumping sources
3 intensity-modulate said pumping light beams
4 according to monitoring control information to be
5 transmitted.

1 20. The optical amplifying apparatus according to
2 claim 11, wherein said pumping sources
3 intensity-modulate said pumping light beams
4 according to monitoring control information to be
5 transmitted.